इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 12475-2 (1988): Gassing of Insulating Liquids Under Electric Stress and Ionization, Part 2: Method of Determination of Gassing Rate Under Nitrogen Atmosphere [ETD 3: Fluids for Electrotechnical Applications]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

(Reaffirmed 2003)

Indian Standard

SPECIFICATION FOR GASSING OF INSULATING LIQUIDS UNDER ELECTRIC STRESS AND IONIZATION

PART 2 METHOD OF DETERMINATION OF GASSING RATE UNDER NITROGEN ATMOSPHERE

UDC 621·315·615 : 543·27

© *Copyright* 1989

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 1989

Indian Standard

SPECIFICATION FOR GASSING OF INSULATING LIQUIDS UNDER ELECTRIC STRESS AND IONIZATION

PART 2 METHOD OF DETERMINATION OF GASSING RATE UNDER NITROGEN ATMOSPHERE

0. FOREWORD

0.1 This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards on 22 August 1988 after the draft finalized by the Liquid and Gaseous Dielectrics Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The electrical performance of oil impregnated paper insulation used in transformers, cables or capacitors is strongly affected by the presence of small gaseous bubbles which can give rise to partial discharges eventual insulation breakdown. Therefore, gassing properties of insulating liquids, that is, the tendency to absorb or evolve gases have been recognized as factors of major importance to characterize the dielectric liquids used as impregnant in oil paper insulation.

0.3 The gassing behaviour of any liquid is primarily a function of its chemistry but change in certain test parameters can modify the result significantly.

The transaction from gas absorption to gas evaluation can occur at different temperatures and applied voltage for different oils.

Although there is some controversy about the relevance of gassing cell tests to ionization condition in electrical equipment under operation, it is generally agreed that gas absorbancy of the impregnant is an essential requirement for minimizing ionization problems in impregnated insulation system used at high electrical stress. However, correlation of gassing cell test results with equipment performance is limited.

0.4 This standard describes procedures to measure the tendency of insulating liquids to evolve or absorb gas when subjected to electrical stress of sufficient intensity to cause an electric discharge through a gas phase in which a gas-oil interphase is located.

0.4.1 Gassing of insulating liquids can be determined by two methods, each using a separate set of apparatus.

0.4.2 This standard (Part 2) describes the method to determine the gassing characteristics of an insulating liquids under nitrogen atmosphere and expresses the result in terms of the change in gas volume after a specified test period.

0.4.3 Part 1 of this standard describes the method to determine the gassing tendency of an insulating liquid under hydrogen atmosphere and expresses the results in terms of gassing rate over a relatively short test period.

0.4.4 The use of this method with other liquids may require some adaptations in dimensions of the gas cell.

0.5 In the preparation of this standard, assistance has been derived from IEC Document 10 A (Central Office) 53 Draft, 'Gassing of insulating liquids under electrical stress and ionization', issued by the International Electrotechnical Commission (IEC).

0.6 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated is to be rounded off, it shall be done in accordance with IS : 2-1960*.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 2) covers the method to determine whether insulating liquids are gas evolving or gas absorbing under the test conditions when subjected to electric stress of sufficient intensity to cause an electric discharge through a gas phase in which a gas-oil interface is located under a nitrogen atmosphere.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 335-1983* shall apply.

---

*Specification for new insulating oils (*third revision*).

3. GENERAL TEST CONDITIONS

3.1 In this method, the quantity of gas absorbed or evolved is obtained of mm changes in gas volume. The test duration in this method is much longer and also the gas volume in contact with liquid in the cell is limited. Due to this, the gases which evolved at early stages can substantially modify the chemical nature of the gas phase thereby influencing the gassing rates.

The gassing cell and the insulating oil sample should be dried, degassed and saturated with nitrogen, then the oil and the nitrogen pocket above the oil are subjected to radial electrical stress under the following conditions:

Voltage : 12 kV
Frequency : 50 Hz
Temperature : 80 ± 1°C
Test duration : 18 h

4. APPARATUS

4.1 Gassing Cell and Burette Assembly — The gassing cell shown in Fig. 1 with dimensions as given in Fig. 2 and Fig. 3 is made out of borosilicate glass with following dimensions.

Tube length : 180 ± 1 mm
Tube inside diameter : 16·00 ± 0·02 mm
Tube outside diameter : 20·80 ± 0·02 mm

The outer electrode (high voltage) is made of aluminium foil of 0·1 mm thickness and 110 mm width. The foil is wound around the tube and is fixed by a suitable plastic adhesive tape so that it will embrace the glass cell very tightly. The high voltage supply is connected to the foil by a braided copper lead.

The inner electrode (earth) is made of tool steel and is earthed by a braided copper lead.

4.2 Gas Burette

a) Volume : 20 cm^3 (within etched scale),
b) Outside diameter : 13 mm (graduated in 0·1 cm^3), and
c) Inside diameter : 11·0 ± 0·5 mm

4.3 Connecting Hose — Made out of fluorinated elastomer for connecting inner electrode to the gas.

Hose length : 150 mm
Hose inside diameter : 6 mm
Wall thickness : 2 mm

4.4 Capillary Tube — Made out of polyethylene and used for introducing test gas (N_2) into the gassing cell.

Tube length : 750 mm
Tube inside diameter : 0·4 mm
Tube outside diameter : 1·1 mm

4.5 Heating Device — A transparent bath filled with silicone liquid is kept on a hot plate (thermostatically controlled) with magnetic stirrer. The temperature of the bath should be maintained at 80 ± 1°C. The bath should be equipped with suitable supports for holding the gassing cell apparatus.

4.6 Transparent Safety Shield — Fitted with safety electrical interlock switches to protect the operator from parts under high voltage.

4.7 Glass Syringe — Volume 5 cm^3.

4.8 Holding Device (*see* Fig. 4) — Preferably made of resin-bonded laminated paper with polyamide screws or of polymethylemethacrylate resin, for holding the test tube:

a) during the filling and assembly of the whole apparatus in the inverse position, and
b) during the test, in the normal position in the oil bath.

The holding device shall be equipped with guides and a resilient mounting for the gassing-cell, with a spring-loaded thrust plate and a retainer to hold it in a correct central position, and with guides and sockets for the high voltage and earth potential leads. The design shall be such as to withstand a voltage of 20 kV between high voltage and earth sockets.

4.9 High Voltage Transformer — The transformer and its controlling equipment shall be of such size and design that, with a filled gassing-cell in the circuit, the peak factor of the voltage (ratio of peak to rms voltage) shall not differ by more than ± 5 percent from that of a sinusoidal wave while maintaining 12 kV (rms) ± 2 percent.

4.10 Thermometer — Any convenient thermometer for measuring temperature up to 100 °C.

5. REAGENTS

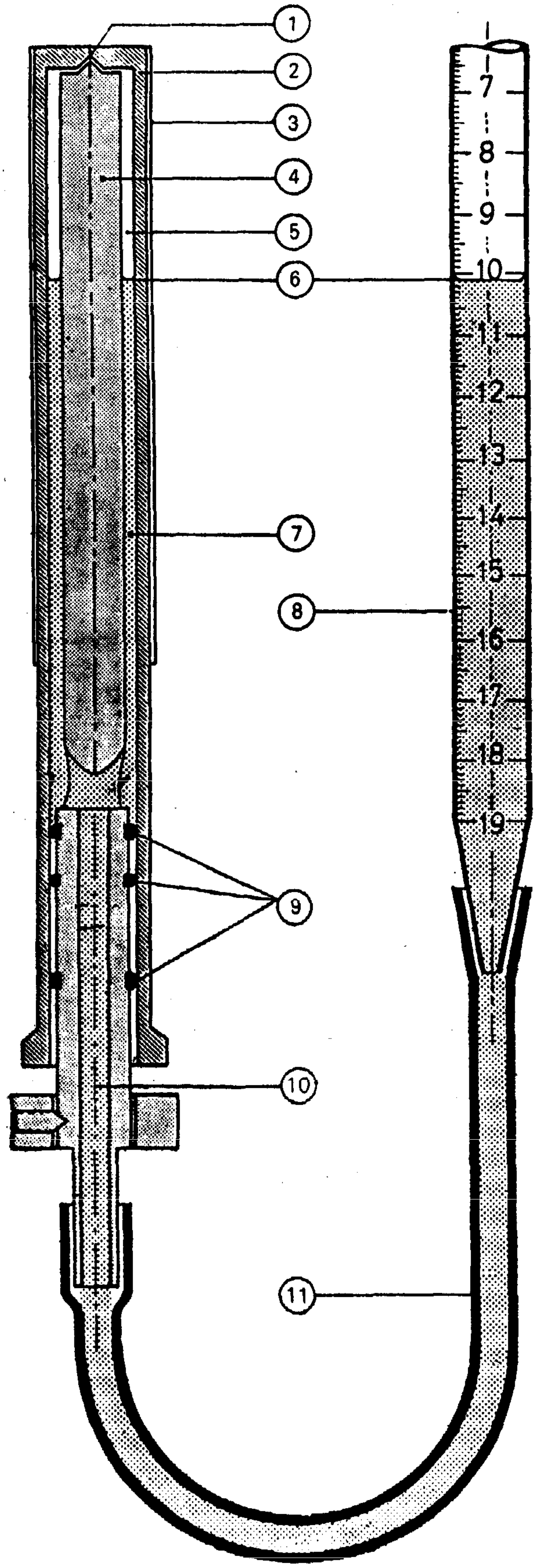
5.1 1,1,1-trichloroethane (technical grade).

5.2 n-heptane (analytical grade).

5.3 Nitrogen, oxygen content less than 10 mm^3/dm^3 and water content less than 2 mm^3/dm^3, from a cylinder with 2 stage pressure reducer and a fine flow regulator.

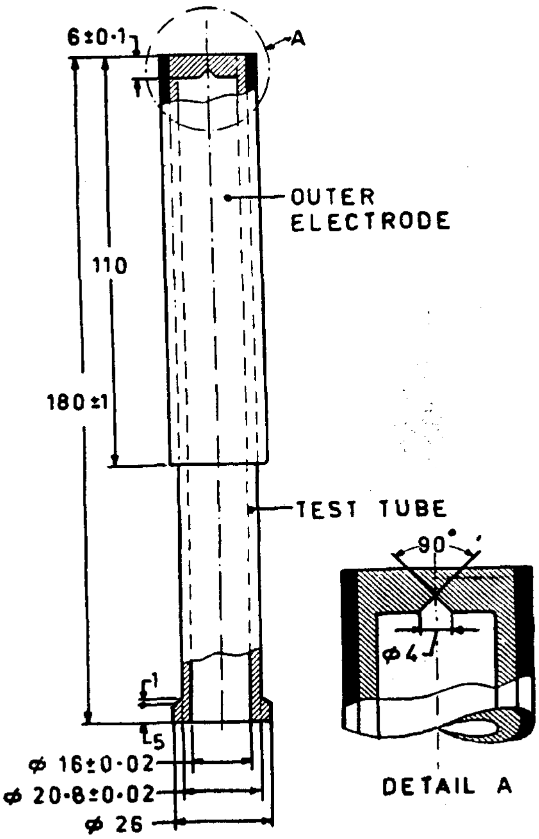
6. PREPARATION OF APPARATUS

6.1 General Remark — As the gassing tendency of liquids may be strongly influenced by solvents, it is important that no traces of solvent remain after the cleaning process.



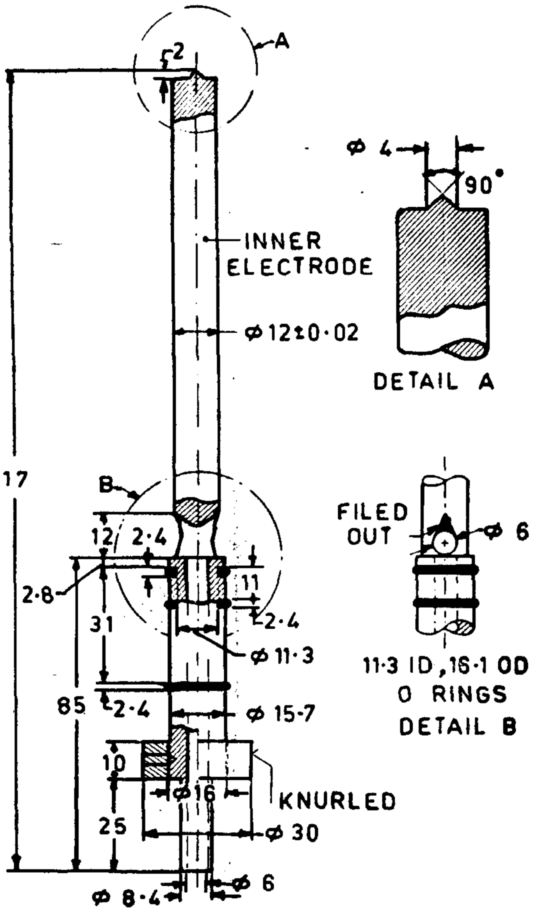
1. Centring cone
2. Glass cell
3. Outer electrode (Al foil)
4. Inner electrode
5. Gas pocket
6. Oil level
7. Oil specimen
8. Burette
9. Sealing rings
10. Oil duct
11. Connection tube

Fig. 1 Gassing-Cell and Burette Assembly



All dimensions in millimetres.

FIG. 2 GASSING-CELL



All dimensions in millimetres.

FIG. 3 INNER ELECTRODE

6.2 Dismantle the gassing-cell and burette.

6.3 Clean the test tube, the inner electrode, the gas-burette and the connecting tube by rinsing them inside and outside first with 1, 1,1-trichloroethane, and then with *n*-heptane.

Normally, the inside of the test tube shall be scrubbed with a stiff polyamide brush to remove waxy deposits from the previous test. Moreover, it is useful to polish the surface of the inner electrode carefully from time to time with buffing compound and then with tissue paper moistened with 1,1,1-trichloroethane.

Rinse again first with 1,1,1-trichloroethane, then with *n*-heptane.

Blow dry with dry compressed air and complete drying in an oven at 80°C.

6.4 Clean the syringe with *n*-heptane and then blow dry with dry compressed air.

7. PROCEDURE

7.1 Wrap the high-voltage electrode round the outside of the glass cell and fix it with suitable adhesive tape. The electrode shall embrace the glass cell tightly and its top edge shall terminate level with the top edge of the end plate of the glass cell (*see* Fig. 5).

7.2 Insert the glass cell vertically in the holding device with the open end up.

7.3 Fit the connecting hose on to the gas-burette and the inner electrode and secure it with clamping rings.

Insert the capillary tube into the burette and push it through until it projects out of the mouth of oil duct of the inner electrode and extends to the electrode.

7.4 Filter about 50 cm^3 of the oil sample through a previously dried filter paper and rapidly introduce 20 cm^3 of the filtered oil into the glass cell.

7.5 Carefully insert the inner electrode to the end plate of the tube in such a way that the oil slowly rises through the oil duct in the inner electrode and connecting hose into the burette.

The capillary tube (*see* **7.3**) shall extend to the bottom of the test tube.

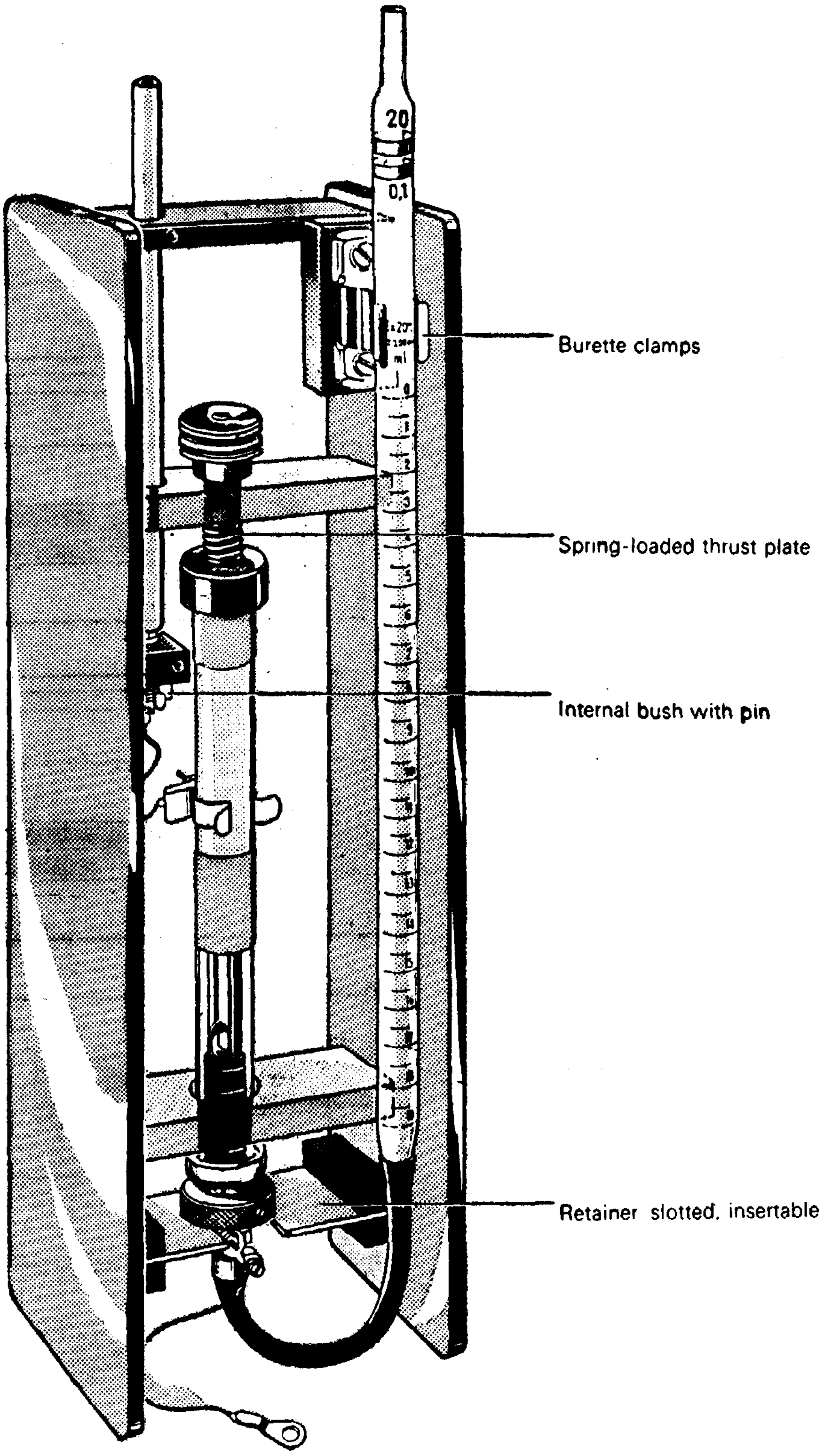
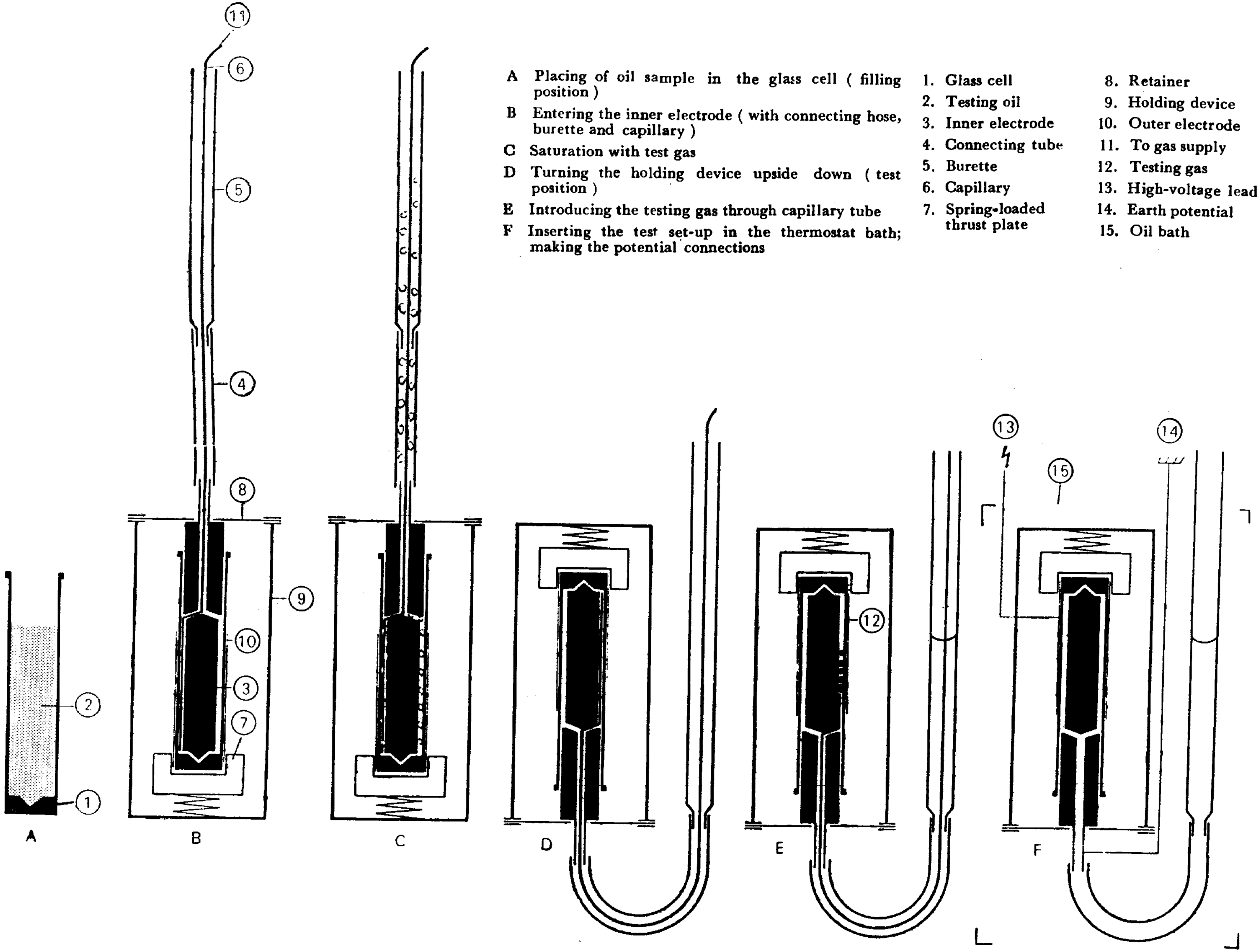


FIG. 4 HOLDING DEVICE, PREFERABLY MADE OF RESIN-BONDED LAMINATED PAPER CONNECTED BY MEANS OF COUNTERSUNK POLYAMIDE SCREWS



A Placing of oil sample in the glass cell (filling position)

B Entering the inner electrode (with connecting hose, burette and capillary)

C Saturation with test gas

D Turning the holding device upside down (test position)

E Introducing the testing gas through capillary tube

F Inserting the test set-up in the thermostat bath; making the potential connections

1. Glass cell
2. Testing oil
3. Inner electrode
4. Connecting tube
5. Burette
6. Capillary
7. Spring-loaded thrust plate
8. Retainer
9. Holding device
10. Outer electrode
11. To gas supply
12. Testing gas
13. High-voltage leads
14. Earth potential
15. Oil bath

Fig. 5 Schematic Representation of the Test Preparations (Drawings are not to Scale)

Clamp the gas-burette to a tripod so that the entire set-up is in a vertical position with the burette at the top and the cell and electrodes at the bottom. Then pour 5 cm^3 of the filtered oil into the burette by means of a syringe.

7.6 Connect the free end of the capillary tube to nitrogen supply. Before doing this, thoroughly purge the connecting line with nitrogen.

7.7 Saturate the oil with dry nitrogen at a flow rate of 3 dm^3/h for 1 h and at room temperature. After that, shut off the nitrogen supply and carefully remove the nitrogen bubbles remaining in the test tube, the oil duct and the connecting hose by repeatedly squeezing the connecting hose.

7.8 Disconnect the burette from the tripod without separating the nitrogen connections.

Clamp the glass cell with the inner electrode to the holding device by means of the retainer and then turn the holding device upside down, keeping the gas-burette vertical. Then clamp the burette to the holding device.

7.9 Record the oil level in the burette.

Inject 3 cm^3 of nitrogen directly from the nitrogen supply through the capillary tube into test tube, recording the volume injected from the indication on the burette.

Then remove the capillary tube.

7.10 Connect the high-voltage socket (on the holding device) to high-voltage electrode and the earth potential socket (on the holding device) to the shank of the inner electrode by means of braided copper leads and clamp the latter in position.

7.11 Place the test apparatus in the oil bath at room temperature (*see* Note), and raise the temperature in about 1 h to the test temperature (80° ± 0·5°C).

NOTE — Do not place the test apparatus in a hot bath, otherwise the glass might break.

7.12 About 1 h after the test temperature has been reached, that is, on further change is noticeable in the oil level, record the oil level in the burette (a cm^3, time t_0).

Connect the high-voltage and earth potential leads.

Place the safety shield in position and then apply a voltage of 12 kV.

7.13 After 18 h, record again the burette level (b cm^3, time t_1).

7.14 Disconnect the test voltage, switch off the heater and start the circulating cooling system.

7.15 Before taking the test apparatus out of the oil bath, allow to cool to a temperature below 40°C.

NOTE — Do not remove the test apparatus from the hot bath, otherwise the glass might break.

8. CALCULATION OF RESULTS

8.1 Calculate the degree of gassing in the presence of nitrogen according to the following formula:

$$G = (a - b) \times \frac{P}{101{\cdot}3}$$

where

G = gassing tendency in cubic centimetres,

a = burette reading at the beginning of the test (time t_0) in cubic centimetres,

b = burette reading at the end of the test (time t_1) in cubic centimetres, and

P = barometer reading in kPa.

The value G will be positive if gas is evolved and negative if the gas is absorbed.

NOTE — The stressed volume in the specified cell is about 10 cm^3. Accordingly, test results can range between $-3{\cdot}0$ and $+7{\cdot}0$ cm^3.

9. NUMBER OF TESTS

9.1 Tests should be run in duplicate.

10. REPORT

10.1 It shall include the following:

a) Gassing tendency (cm^3), mean value of duplicate tests;

b) Test voltage, test temperature; and

c) Test period, gas phase, etc.

11. PRECISION

11.1 It is not yet adequately defined. However, the following figures may be considered indicative for judging the acceptability of the results.

11.1.1 *Repeatability* — Replicate results by the same operator should not be considered suspect unless they differ by more than 0·5 cm^3.

11.1.2 *Reproducibility* — The results submitted by each of the two laboratories should not be considered suspect unless they differ by more than 1 cm^3.

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 3310131, 3311375

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:	Telephone
Central: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 10002	3310131, 3311375
*Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	362499
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	21843, 31641
Southern : C. I. T. Campus, MADRAS 600113	412442, 412519, 412916
†Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	6329295

Branch Offices:	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	26348, 26349
Peenya Industrial Area, Ist Stage, Bangalore-Tumkur Road, BANGALORE 560058	384955, 384956
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	66716
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	53627
53/5 Ward No. 29, R. G. Barua Road, 5th Byelane, GUWAHATI 781003	—
5-8-56C L. N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	231083
R14 Yudhister Marg, C Scheme, JAIPUR 302005	63471, 69832
117/418 B Sarvodaya Nagar, KANPUR 208005	216876, 218292
Patliputra Industrial Estate, PATNA 800013	62305
T.C. No. 14/1421, University P.O., Palayam, TRIVANDRUM 695035	62104, 62117

Inspection Offices (With Sale Point):	
'Pushpanjali', First Floor, 205A West High Court Road, Shankar Nagar Square, NAGPUR 440010	25171
Institution of Engineers (India) Building, 1332 Shivaji Nagar, Pune 411005	52435

---

*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072 — 276800

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400097 — 896528

Printed at New India Printing Press, Khurja, India